

Appl. No. 10/640,340
Amdt. Dated July 27, 2006
Reply to Office Action of December 16, 2005

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REMARKS

Applicants have now cancelled claims 5-18 and 20, amended claims 1, 4, and 19, added claims 21-23, and amended the specification and the abstract. The subject matter of claim 21 appeared in claims 1 and 7, as originally filed, while claims 22 and 23 are similar to original claims 3 and 4, respectively. Additionally, the Examiner indicated in the Office Action that "catalyst dopant" is supported by the original disclosure. Therefore, no new matter has been entered via any of the above amendments.

Amendment Objection to Specification

The amendment filed on 3/16/2006 is objected to under 35 U.S.C. 132(a) because it introduces new matter in the disclosure. Specifically, the added "growth-affective material" is not supported by the original disclosure.

In response to this objection, Applicants have amended the specification, keeping in mind the comments offered by the Examiner. Specifically, the phrase "growth-affective" has been replaced by "catalyst dopant" throughout the specification. The Examiner indicated in the Office Action that "catalyst dopant" is supported by the original disclosure. As such, Applicants submit that the objection to the disclosure has been successfully overcome and that the disclosure is now in allowable form.

Claim Rejections Under 35 U.S.C. 112

Claims 1-7 and 19-20 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. Specifically, the

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phrase "growth-affective" is not supported by the original disclosure.

In response to this rejection, Applicants have amended claims 1, 4, and 19 and canceled claims 5-7 and 20, keeping in mind the comments offered by the Examiner. As discussed above, the phrase "growth-affective" has been replaced by "catalyst dopant" where necessary throughout the specification, including the claims. Applicants submit that the amended claims 1-4 and 19 now comply with the enablement requirement and are thus in allowable form.

Double Patenting rejection

Claims 1 and 19 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1 and 17 of copending Application Nos. 10/640, 432 and claim 1 of copending Application Nos. 10/745, 251.

In response to this rejection, attached herewith is a copy of an appropriately executed Terminal Disclaimer. Accordingly, it is believed that the rejection is overcome.

Claim Rejections Under 35 U.S.C. 103

Responsive to the rejection of Claims 1-5 and 19 under 35 U.S.C. 103(a) as being unpatentable over "Carbon Nanotube Arrays Prepared by MWCVD" in view of USP 6,232,706 to Dai taken with USP 5,653,951 to Rodriguez. Applicants have amended claims 1, 4, and 19; have canceled claims 5-7 and 20; and hereby otherwise respectfully traverse this rejection.

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Claim 1, as amended, recites in part:

...a plurality of alloy catalytic nano-sized particles formed on the substrate, said alloy catalytic nano-sized particles each comprising a catalyst material and a catalyst dopant material, a content of said catalyst dopant material gradually one of increasing and decreasing along a predetermined direction on said substrate... (Emphasis added.)

Applicants submit that, with respect to amended claim 1, *a prima facie case* could not be established for obviousness of the claimed invention over Yao reference in view of Dai '706 taken with Rodriguez '951, as required under 35 U.S.C. §103.

The Yao reference discloses highly aligned carbon nanotubes grown on metallic substrate by MWCVD (bias-enhanced microwave plasma CVD). The process of growing the carbon nanotubes on metallic surfaces is disclosed in the first paragraph of the third section (Results and Discussion, pp. 11395-6) and FIG. 1. In this process, the carbon nanotubes are directly grown on a surface of the metallic substrate. The surface of the substrate is covered by a thin layer of amorphous carbon with metal nanoparticles embedded therein. These metal nanoparticles, in fact, act as the catalyst. The Yao reference does not disclose or suggest that these catalytic metal particles should be particularly doped in any manner.

The Examiner provides Dai '706 as a disclosure of the use of nano-sized catalytic particles to use in nanotube growth and contends that

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Dai '706 teaches that the control of the nanotube diameter based upon the size of catalytic material used. Two points must be raised here. First and foremost, the issue is not whether the diameter of the nanotubes can be controlled based on the size of the catalytic particles. Instead, as set forth in claim 1, as amended, the issue is whether progressive bending can be controlled based on the amount of dopant present found in such catalytic particles along a given direction. Neither Yao nor Dai '706 disclose or suggest even providing a dopant within the catalytic particles.

Secondly, even if nanotube-diameter control based on the diameter of the catalytic particles were actually being claimed (it is not in claim 1), Dai '706 would not even teach or suggest that sort of relationship. Dai '706 actually discloses that "[bundles] 28 have the same "footprint" size and shape as the catalyst material pattern 26." Applicants duly note that the bundle size/shape is not the same of the diameter of an individual nanotubes within a given bundle, nor does the footprint of the pattern 26 have anything to do with any sort of dopant concentrations therein.

Accordingly, Applicants submit, for the reasons set forth above, Dai '706 does not disclose or suggest the provision of a dopant within the catalyst material and thus is clearly unable to suggest that such a content is to vary in a given direction, as required by amended claim 1.

Rodriguez '951 disclose carbon nanostructures grown on a substrate with a catalytic metal particle precursor deposited thereon. The catalysts are typically alloys or multi-metallics comprised of a first metal selected from the metals of Group IB of the Periodic Table of the Elements, and a second metal selected from the group consisting of Fe, Ni, Co, Zn, or

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mixtures thereof (see column 5, lines 15-40). While Rodriguez '951 may disclose the use of second or dopant metal, it does not disclose or suggest varying the amount of that dopant within the catalyst over the substrate upon which it is deposited (e.g., content varied in a chosen manner, along a given direction). Accordingly, Applicants submit that Rodriguez '951 fails to teach or suggest "a content of said catalyst dopant material gradually one of increasing and decreasing along a predetermined direction on said substrate....", as set forth in amended claim 1.

None of the cited references does disclose, suggest or teach "a plurality of alloy catalytic nano-sized particles comprising a catalyst material and a catalyst dopant material with a content thereof gradually one of increasing and decreasing along a predetermined direction on said substrate...", as set forth in amended claim 1. Therefore, Applicants submit that Yao reference in view of Dai '706 taken with Rodriguez '951 does not teach or suggest each and every element of amended claim 1.

Accordingly, Applicants submit that amended claim 1 is unobvious and patentable over Yao reference in view of Dai '706 taken with Rodriguez '951 or any of the other cited references, taken alone or in combination, and is now in condition for allowance, the allowance of which is hereby respectfully requested.

Claims 2-4 each are directly dependent from claim 1, and, as such, Applicants submit that claims 2-4 should also be allowable.

Claims 5-7 have been canceled without prejudice, and the rejection thereof is now considered moot.

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Claim 19, as amended, recites in part:

...a plurality of alloy catalytic nano-sized particles formed on the substrate, said alloy catalytic nano-sized particles each comprise a catalyst material and a catalyst dopant material, a content of said catalyst dopant material one of increasing and decreasing along a direction on said substrate ... (Emphasis added.)

Applicants submit that, with respect to amended claim 19, *a prima facie case* could not be established for obviousness of the claimed invention over Yao reference in view of Dai '706 taken with Rodriguez '951, as required under 35 U.S.C. §103, for reasons similar to those set forth above with amended claim 1. Specifically, none of the references even disclose or suggest controllably varying a content of the catalyst dopant material over a given direction. Thus, none of the cited references does disclose, suggest or teach "a plurality of alloy catalytic nano-sized particles comprising a catalyst material and a catalyst dopant material with a content thereof one of increasing and decreasing along a direction on said substrate...", as provided by amended claim 19. Therefore, Applicants submit that Yao reference in view of Dai '706 taken with Rodriguez '951 does not teach or suggest each and every element of amended claim 19.

Accordingly, Applicants submit that amended claim 19 is unobvious and patentable over Yao reference in view of Dai '706 taken with Rodriguez '951 or any of the other cited references, taken alone or in combination, and should be allowable.

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Claim 20 has been canceled without prejudice, and the rejection thereto is moot now.

New Claims

New claims 21-23 are provided to protect the subject matter of the present invention.

New claim 21 recites in part:

...a plurality of alloy catalytic nano-sized particles formed on the substrate, said alloy catalytic nano-sized particles each comprising a catalyst material and a catalyst dopant material, said catalyst dopant material being in a form of a layer, said layer one of thickening and thinning along a predetermined direction on said substrate... (Emphasis added.)

In a manner similar to that argued with respect to claim 1, none of the cited references does disclose, suggest or teach "a plurality of alloy catalytic nano-sized particles comprising a catalyst material and a catalyst dopant material which is in a form of layer and either thickened or thinned along a predetermined direction on said substrate..." Specifically, one of ordinary skill in the art would recognize that the available content of the catalyst dopant material would increase with increasing thickness or vice versa. Therefore, Applicants submit that Yao reference in view of Dai '706 taken with Rodriguez '951 does not teach or suggest each and every element of amended claim 21.

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Accordingly, Applicants submit that, with respect to new claim 21, *a prima facie case* could not be established for obviousness of the claimed invention over Yao reference in view of Dai '706 taken with Rodriguez '951, as required under 35 U.S.C. §103. Applicants submit that new claim 21 is unobvious and patentable over Yao reference in view of Dai '706 taken with Rodriguez '951 or any of the other cited references, taken alone or in combination, and should be allowable.

Since claims 22 and 23 each are directly dependent from claim 21, Applicants submit that claims 22 and 23 should be allowable, as well.

Conclusion

In view of the foregoing, the present application as claimed in the pending claims is considered to be in a condition for allowance, and an action to such effect is earnestly solicited.

Respectfully submitted,
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